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(19)

(54) IMPROVEMENTS IN AND RELATING TO A PROCESS FOR INJECTION MOULDING PLASTICS ARTICLES

(71) We, CREUSOT - LOIRE, a French Corporate Body, of 42, rue d'Anjou, 75008 Paris, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a process for injection-moulding plastics articles which possess coloured zones, and to a machine for carrying out this process.

Various processes for obtaining multi-coloured plastics injection-mouldings are known. In addition to the process of moulding one material over another, various processes are known which make it possible to obtain articles possessing different colours, by simultaneous or successive injections of a plastics in different colours.

A first process consists in injecting into a mould, either by means of a torpedo barrel, or by means of a special screw plunger, or by means of a device combining these two components, products which have been mixed cold before being placed in the hopper, these products being of different colours and also differing in respect of their plastic behaviour as a function of temperature.

Since the plastic behaviour of these products at a given temperature is different and plasticisation is not necessarily followed by good homogenisation, the result, as far as the general appearance of the injection-moulding is concerned, is a marbling effect which is oriented in the direction of flow of the material in the mould. It is this effect which is sought after for decorating certain plastics products.

A second process consists in using two products of different colour, each of these being plasticised separately in a separate unit and being injected into a common feed, either simultaneously or successively, depending on the desired effect in the moulding.

In this case, the number of colours is obviously related to the possibility of increasing the number of injection heads. In this process, the distribution of colours in the moulding takes place concentrically about the feed point. The fusion between each of these colours depends on how one injection is regulated relative to the other.

A third process consists in successively injecting into a mould, at several injection points, and from as many injection heads, products of different colour, the boundaries between which, in the mould, are defined in a precise manner by removable mechanical elements.

The first process is inexpensive because it does not require any special equipment and because a conventional injection machine, when fed with a product in different colours, allows multi-coloured articles to be obtained.

However, the field of application of this process is limited because it is not possible to orient one of the colours relative to the other since the lack of homogeneity affects the whole of the plasticised and injected material, which is of course the object of this process. The field of application is thus limited to obtaining articles made from a marbled plastics, wherein the colour distribution is completely random.

The two other processes require complex and expensive machines because it is necessary to provide a complete plasticisation and injection unit for each of the plastics materials to be injected; the whole machine becomes particularly complex where articles having a large number of colours are desired. This even technologically limits the possibility of increasing the number of colours, even supposing that the disadvantage of an expensive investment corresponding to extremely complex equipment is accepted.

According to one aspect of the invention there is provided a process for injection moulding a plastics article which possesses at least one zone having a colour different from that of another part of the article, comprising plasticising a mass of material having a homogeneous colour and corresponding

substantially to the mass required for the article, holding the plasticised mass in an uncompresssed state in a rigid chamber, injecting a precise amount of at least one colorant into the plasticised mass at a precise point while the mass is maintained in an uncompressed state, and, thereafter, applying pressure to the plasticised mass to inject it into a mould for the article.

According to another aspect of the invention there is provided an injection-moulding machine for carrying out the above method, the machine comprising an injection chamber for plasticised material to be moulded and communicating with a mould, a device for plasticising the material, means for exerting pressure on the plasticised material when in the injection chamber, and a colouring device comprising at least one injector which communicates with the injection chamber and is connected, for supply thereto of colorant under pressure, to a metering pump, and includes a shut-off device, the metering pump being associated with control means for actuating the pump at the end of plasticisation of the material.

The invention will be more fully understood from the following description of an embodiment thereof, given by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a longitudinal section through an embodiment of an injection-moulding machine which includes a colouring device according to the invention;

Figure 2 is a view in cross-section, through one of its planes of symmetry, of a first embodiment of an injector for the colouring device shown in Figure 1;

Figure 3 is a section similar to that of Figure 2, of a second embodiment of an injector for the colouring device of Figure 1; and

Figure 4 schematically represents a control circuit for the colorant injectors of the colouring device of Figure 1.

Figure 1 shows an injection-moulding machine comprising a screw plunger 1. Rotation of the screw 1 inside barrel 2 plasticises the material which then fills injection chamber 3. After plasticisation is complete and the injection chamber 3 is full of plasticised material, operation of the screw plunger 1 causes the material to be injected through channel 4 and nozzle 5 into a mould located at the outlet of the nozzle 5. To carry out this injection, the screw 1 is brought into contact with sealing ring 8 which thus forms, with the screw 1, a plunger for injecting the material in the chamber 3.

In addition to the barrel 8 and the nozzle holder 9 which are found in conventional machines, the injection-moulding machine possesses an injector holder 10 inside which are located injectors 11, two of these injectors being shown in Figure 1.

The injector holder 10 is fixed at one of its ends to the barrel, the holder 10 and barrel 2 being threaded at 12, and at its other end to the nozzle holder by means of a fixing member or socket 14 screwed into the injector holder.

Gaskets provide a seal between the barrel and the injector holder and between the injector holder and the nozzle holder.

An injector 11, shown in Figure 1, is shown in more detail in Figure 2. The injector comprises a body 15, fixed in a leaktight manner, for example by welding, in the through-bore provided in the injector holder. The body has, at its lower end, an orifice 16 of small diameter, which opens into the interior of the injector holder, that is to say into the injection chamber 3. The upper part of the injector is formed by a closure member 18, the lower part of which is threaded to enable it to be assembled with the body 15 of the injector, the member 18 having a circular orifice 19 opening, at its upper end, into the atmosphere. The body 15 and the member 18 are hollow so that they form a chamber 20 inside which is located a needle-valve 21. The needle-valve 21 is held in its lowered position by means of a spring 22 acting between the upper part of the member 18 and an intermediate part 27 of the needle-valve, which is mounted in a leaktight manner like a piston inside the body 15 of the injector. The upper part of the needle-valve 21 projects through the orifice 19 in the closure member 18, and the conical lower end of the needle-valve closes the orifice 16 when the needle-valve is in its lowered position.

A channel 23 extends centrally through part of the needle-valve and communicates, via a coupling 24, with a pipeline 25 connected to the source of colorant under pressure. In the present case, piston pumps supply liquid colorant under pressure to the injector via the pipeline 25. The central channel 23 of the needle-valve injector terminates slightly below the intermediate piston-like part 27 of the needle-valve in radial channels 26 which open into the chamber 20 in which the needle-valve is mounted.

Colorant under pressure can thus fill the lower part of the chamber, defined by the piston-like part 27 of the needle-valve. The colorant thus exerts a pressure on the needle-valve, which tends to cause the needle-valve to rise against the action of the spring 22. The entry of colorant under pressure into chamber 22 thus causes this needle-valve to open, the apparatus being balanced so that the needle-valve will open under the action of the pressure exerted by the colorant. The liquid colorant can thus flow

through the orifice 16 of the injector into the injection chamber 3.

When the supply of liquid colorant by the piston pumps of the injector stops, the spring 22 returns the needle-valve to its closed position closing the orifice 16. The injection chamber 3 is thus isolated from the injectors, the cross-section of the orifice 16 being calculated to be such that the injection pressure cannot cause the needle-valve to lift when the plasticised material is pushed forwards by the screw plunger 1.

Accordingly, the apparatus functions as follows: when the material to be plasticised has been brought to the rotating screw 1 through an orifice in the barrel, the screw plasticises the material and pushes it forwards into the injection chamber 3, which fills with plasticised material. During this plasticisation, the screw 1 moves backwards at the rate at which the chamber 3 is filled, until a volume of plasticised material sufficient for moulding the article in question is in the injection chamber 3. At that instant, the screw, as it moves backwards, encounters an electrical contact which causes the rotational movement of the screw to stop and brings into operation the piston pumps connected to the pipelines 25 connected to the injectors 11.

The arrival of colorant under pressure in the pipelines 25 opens the needle-valve injectors, each of which sends a fine and well-localised jet of liquid colorant under pressure into the plasticised material.

The time required for the injection of the desired amount of colorant into certain zones of the injection chamber, in order to produce articles which possess well-defined coloured zones, is determined beforehand.

The colorant penetrates into the plastic without difficulty, since the material is at that stage in an uncompressed state.

Once the injection of colorant has finished, the forward movement of the screw plunger 1 is triggered. The screw plunger comes into contact with the collar 8 and causes the plasticised material contained in the injection chamber 3 and in the channels 4 and 5 to be pushed into the mould. During injection of the plasticised material, the coloured zones located at the positions of the injectors 11 deform and assume a well-defined position in the moulding, which makes is possible to achieve reproducibility of the selected effects and easy regulation of these effects by varying the position, nature and amount of colorants injected into the plasticised material.

Obviously, any number of injectors, each fed with different colorants or identical colorants, can be used, and it is thus possible to achieve multi-coloured effects in a very simple manner and with an apparatus which is very little different from a conventional injection-moulding machine.

This multi-coloured effect is furthermore oriented in the moulding, which makes it extremely easy to regulate the effects to be obtained.

During injection of the material, the injection pressure which acts through the orifice 16 of each injector on the needle-valve is insufficient to cause the needle-valve to move backwards and to bring the chamber of the injector into communication with the injection chamber.

In place of a needle-valve injector as shown in Figure 2, a ball injector as shown in Figure 3 may be used. The injector shown in Figure 3 comprises a body 30 through which a central channel 31 extends. The channel 31 communicates at one end with a connector 32 by which the channel 31 is supplied with a colorant under pressure, and at the other end with a chamber 33 inside which a ball 34 is held by a retaining pin 35. The chamber 33 communicates, at its lower end, with the interior of the injection chamber.

Such a ball injector acts as a one way or non-return valve because, at the instant at which injection commences, the increasing pressure in the chamber 3 applies the ball 34 against a seat 36 formed in the upper end of the chamber 33 where the central channel 31 opens into the chamber 33 to stop flow of colorant into the injection chamber.

When the injection chamber 3 is filled with plasticised material in the uncompressed state, colorant under pressure can push the ball 34 away from its seat 36 so that the colorant flows into the injection chamber 3.

However this device has the disadvantage, compared to the needle-valve injector shown in Figure 2, that the colorant is injected into the plasticised material through an orifice of relatively larger diameter and hence in a less localised manner, and that it does not ensure that the colorant is swept completely out of the injection chamber between two colorant injection operations.

Figure 4 schematically shows a unit for feeding three injectors with different colorants by means of piston type metering pumps 43, 44, 45, of which the chamber on one side of the piston is fed with compressed air and the chamber on the other side of the piston is fed with colorant. The pumps 43, 44 and 45 are fed with compressed air through circuits comprising electromagnetic valves 40, 41 and 42 and flow restrictors 45, 46 and 47 respectively. The compressed air chamber of each pump can also be connected to a pipeline connected at 49 to the atmosphere. The pistons of the pumps, actuated by the compressed air, thus permit colorant to be injected at a constant flow rate, and the flow restrictor located in the compressed

air pipeline allows the speed to be regulated, so as to obtain a harder or less hard jet of colorant. Hence, the penetration of the colorant into the plastic can easily be regulated by regulating the flow restrictors 45, 46 and 47.

When the screw plunger reaches its rear position, after having plasticised a sufficient amount of material, it actuates a contact 50 which causes the electromagnetic valves 40, 41 and 42 to be excited so as to cause the compressed air pump chambers to be supplied with compressed air in order to inject colorant. Since the injection rate remains constant, it is easy to predetermine the injection time required to introduce the desired amount of colorants. The injection time is determined by an adjustable timing circuit which is actuated by actuation of contact 50 and, after a preset time, when the injection of colorant is complete, re-excites the electromagnetic valves 40, 41 and 42 to cause the compressed air chambers of the pumps to be connected to the atmosphere. A return spring then allows the pistons to move in the reverse direction from the injection direction, causing the chambers of the pumps to fill with colorants.

The pumps are then ready for a fresh injection operation during the next cycle of the machine.

It will be appreciated that the number of colours is no way limited and the injection points can occupy any positions along the circumference and along the length of the injection chamber or of the injection channel. The injectors can open at the level of the inner surface of the wall of the injection holder, as in the embodiment which has been described, or can extend towards the centre of the injection chamber to allow colorant to be introduced into the plasticised mass or even at the centre of the plasticised mass.

It is also possible to use metering pumps of any type and control devices for these pumps of any type in order to inject well-defined amounts of colorant material at precise points of the plasticised mass.

The above described method and apparatus are applicable to the production of multi-coloured plastic articles possessing well-localised coloured zones such, for example, as artificial flowers which have hitherto required special machines. It is also possible to produce, using the above described process and apparatus, articles of simpler structure, with coloured zones which are less precisely defined.

Where a sharper division between each of the colours is required in the article produced, a torpedo can be located in the injection chamber, the purpose of the torpedo being to avoid premature mixing of the colours in the injection barrel before or during injection.

Finally, the above described process is particularly well suited to cases where a purely artistic effect of the coloration, in articles of a particular shape, is desired.

There is thus provided a process and machine whereby plastics articles can be made which possess coloured zones, whereby it is possible to achieve good localisation of the coloured zones in the injection-moulding. The apparatus required is simple and can be easily adapted to the production of articles possessing numerous colours.

WHAT WE CLAIM IS:—

1. A process for injection moulding a plastics article which possesses at least one zone having a colour different from that of another part of the article, comprising plasticising a mass of material having a homogenous colour and corresponding substantially to the mass required for the article, holding the plasticised mass in an uncompressed state in a rigid chamber, injecting a precise amount of at least one colorant into the plasticised mass at a precise point while the mass is maintained in an uncompressed state, and, thereafter, applying pressure to the plasticised mass to inject it into a mould for the article.

2. An injection-moulding machine for carrying out a process according to claim 1, the machine comprising an injection chamber for plasticised material to be moulded and communicating with a mould, a device for plasticising the material, means for exerting pressure on the plasticised material when in the injection chamber, and a colouring device comprising at least one injector which communicates with the injection chamber, and is connected, for supply thereto of colorant under pressure, to a metering pump, and includes a shut-off device, the metering pump being associated with control means for actuating the pump at the end of plasticisation of the material.

3. A machine according to claim 2, comprising a cylindrical barrel, a screw plunger movable rotationally and translationally in the barrel for plasticising and injecting the material respectively, and a nozzle holder defining an injection channel which communicates with an itnernal channel of a nozzle for communicating with a mould, wherein the or each injector is located in a cylindrical injector holder inserted between the barrel and the nozzle holder.

4. A machine according to claim 3, including a control switch for operating the metering pump and actuable by the screw plunger in the course of its backward movement during plasticisation.

5. A machine according to any one of

claims 2 to 4, wherein the or each injector is a needle-valve injector actuated in the opening direction by colorant under pressure and in the closing direction by a mechanical spring.

6. A machine according to any one of claims 2 to 4, wherein the or each injector comprises a shut-off device consisting of a ball movable in a chamber, located in the zone where the injector opens into the injection chamber, between an open position under the pressure of colorant and a closed position under the pressure of the material which fills the injection chamber.

7. A process of injection moulding a plastics article substantially as herein described with reference to the accompanying drawings.

8. An injection moulding machine including a colouring device substantially as herein described with reference to the accompanying drawings.

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1586010 COMPLETE SPECIFICATION

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Sheet 1

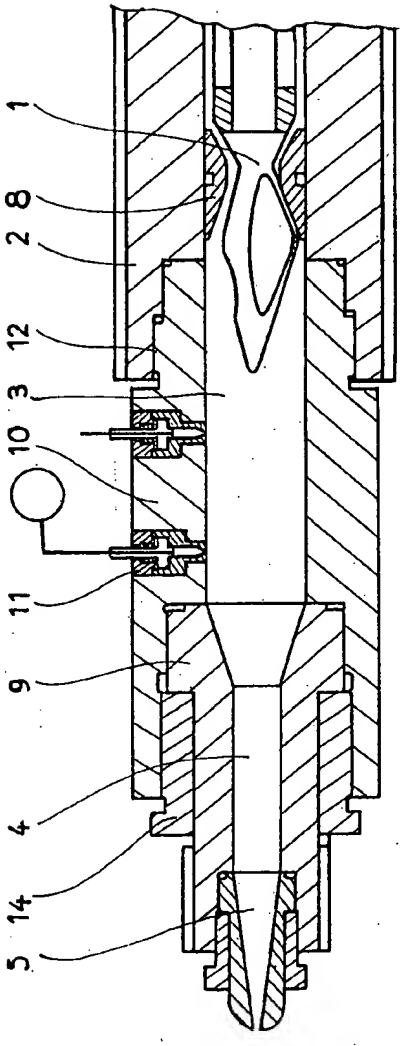

FIG 1

1586010 COMPLETE SPECIFICATION

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Sheet 1

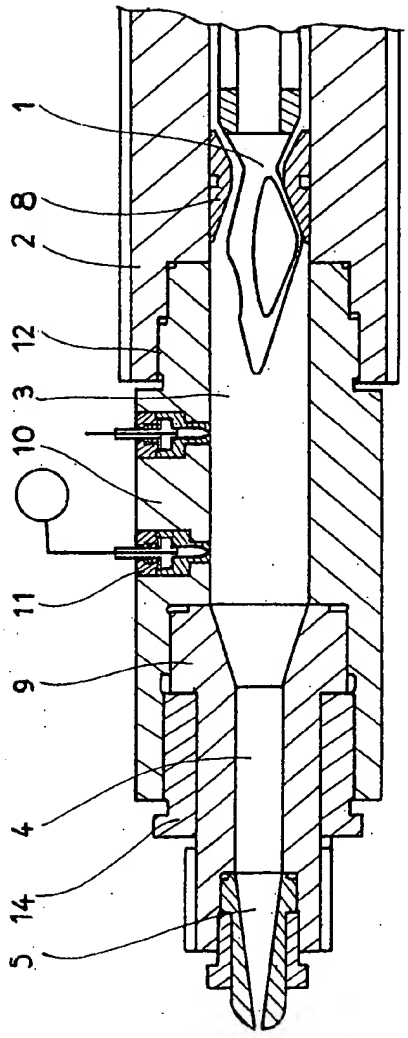

FIG 1

1586010 COMPLETE SPECIFICATION
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Sheet 2

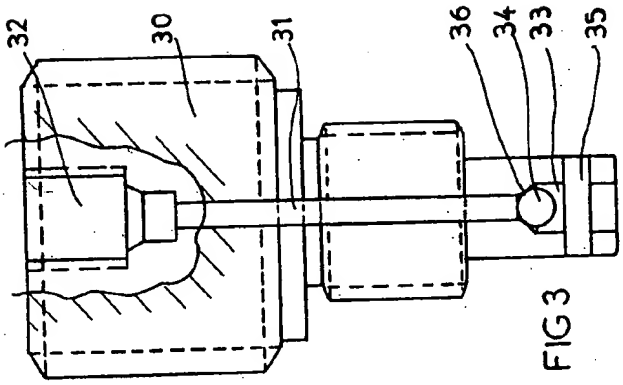

FIG 3

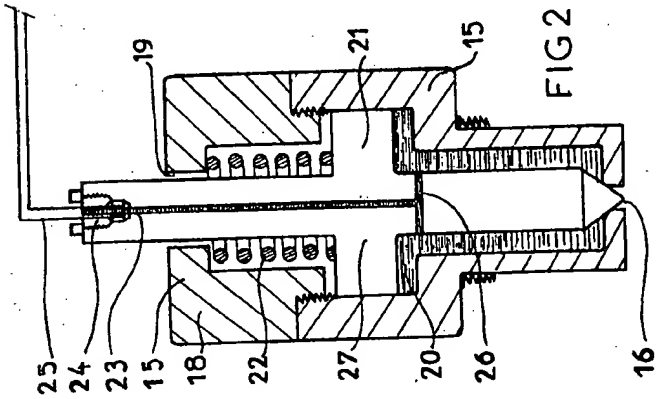

FIG 2

1586010 COMPLETE SPECIFICATION
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Sheet 3

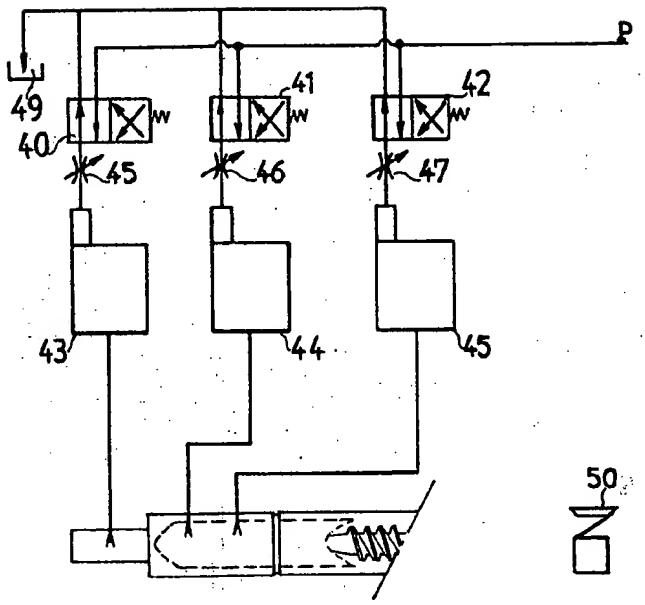

FIG 4